

## **D. RECENT HISTORY OF NUCLEAR ENERGY R&D**

The United States has led the world in commercial nuclear energy technology since its discovery and development in the late 1940s. The Atomic Energy Act of 1954 mandated that peaceful uses of the atom be developed, and required a nuclear energy research program at the Atomic Energy Commission, DOE's predecessor. Early development of nuclear reactor technology was done under government control and funding, with a number of national laboratories and commercial energy companies responsible for the work. The key laboratories involved in new reactor development were Argonne, Oak Ridge, and the National Reactor Testing Station (now INEEL). The commercial companies that entered the nuclear reactor design business included Westinghouse, General Electric, Combustion Engineering, Babcock and Wilcox, and General Atomic.

EPRI was established in 1973 to conduct R&D for the U.S. utility industry on a collaborative, cost-shared basis, in all areas of electricity generation, transmission, and end use. EPRI is primarily a project management organization, and contracts with private sector, university, and government laboratories to carry out the R&D the utilities need. Nuclear power has always been a strong component of EPRI's R&D program.

Nuclear energy R&D has traditionally been a strong component of DOE's mission and the mission of its predecessor organizations, AEC and ERDA. In the 1970s and 1980s, strong R&D programs were developed at DOE in other areas of electrical power generation, surpassing the size of the nuclear R&D program by the mid-1980s. Throughout the 1980s, DOE's focus in advanced reactor development included the liquid metal reactor and the modular high temperature gas-cooled reactor. In the 1980s, DOE also began supporting a joint industry-government cost-shared program to develop Advanced Light Water Reactors (ALWR) -- first two large evolutionary reactor designs, and later, two mid-size, passive safety system designs. This program was a major focus of the Energy Policy Act of 1992, and was a strong and successful program through the mid 1990s.

The focus of nuclear energy research is now changing. With the cancellation of liquid metal and gas-cooled reactor development programs in 1992/1993, and approaching completion of the final ALWR program (the mid-size, passively safe AP600), priorities have shifted to ensuring R&D needs for currently operating plants, including license renewal, are being met, to conducting high priority R&D of a generic nature that will benefit all current and future LWRs, and to supporting a broader range of long-term technology needs which will help sustain U.S. nuclear technology leadership.

In 1995/1996, industry and DOE sharpened their focus on those programs that assure the current plants will continue to perform well and serve as safe and cost effective generating stations through the end of their planned operating lives, which for many will involve renewal of their operating license. The utility industry increased its attention to programs that work to ensure that the physical condition and economic performance of these plants will be such that their licenses could be renewed for an additional twenty-year period of operation. This requires a carefully planned strategic maintenance program at each plant to ensure that the long-life systems, structures and components are maintained in excellent condition, and that those components that

are replaced over the life of the plant are changed out on a schedule that permits a smooth transition into a license renewal period without major short-term investments.

In response to the need for a better overall nuclear energy R&D planning tool for prioritizing funding needs, DOE and industry undertook a formal review of the nuclear energy R&D needs of the nation in 1996. Both organizations developed strategic plans to identify, prioritize, and plan future nuclear research. DOE and industry shared the results of these efforts and used them to coordinate plans for their own nuclear R&D programs, as well as collaborative R&D programs.

To achieve a better analysis and prioritization of R&D needs for 1998 and beyond, EPRI developed, in cooperation with the Advanced Reactor Corporation (ARC), the Nuclear Energy Institute (NEI), and other nuclear industry organizations, "Nuclear Energy R&D Strategic Plan in Support of National Nuclear Energy Needs" in mid-1996 and provided it to DOE to initiate joint planning and coordination toward common R&D goals. The report was updated and resubmitted in June 1997.

DOE's proposed nuclear energy R&D plan for FY98, the "Nuclear Energy Security" Program, relied heavily on these joint planning efforts. The EPRI Nuclear Power Council strongly and unanimously endorsed this program in a June 1997 letter to DOE. But Congress eliminated all funding for commercial nuclear energy R&D for FY98.

Throughout this period, in parallel with joint planning efforts, DOE and EPRI worked to expand their collaboration in R&D related to existing nuclear energy plants, including areas such as Life Cycle Management, Instrumentation and Controls (I&C), BWR vessel internals, PWR vessel annealing, nuclear fuel performance, and spent fuel storage and transportation. In 1996, opportunities for cooperative research were pursued under the "Sustainable Electric Partnership" (SEP), a high-level agreement between DOE and EPRI for joint planning and execution of R&D. Under this SEP, an umbrella cooperative agreement on materials related technology development was agreed to. The plan also included better integration of R&D that supports both license renewal of current plants and improved options to build new plants, particularly in the areas of I&C development and information management technologies. These technology initiatives were reflected in DOE's FY97 and FY98 budgets, but not funded in FY98, leaving nuclear energy as the only primary source of energy in the U.S. without a corresponding Federal R&D program to improve and advance the technology.

A policy to eliminate nuclear energy options from this nation's energy mix, and rely exclusively on other energy options, sets a dangerous course for the nation's future, in view of the energy sector challenges from increasing energy demands, uncertainties in fossil fuel supplies, increasing questions about the consumption of fossil fuels, and industry deregulation. Proposed EPA regulations on fossil fuel emissions, and possible mandatory limits on CO<sub>2</sub> in response to concerns for global warming, will make an energy strategy devoid of a nuclear power option even more risky. The U.S. has always relied on a mix of energy resources as one of its vital economic strengths, and must continue to do so.

Many national leaders, including Senators Murkowski and Domenici, and some members of the Administration concerned about the potential for global climate change and anxious to provide

assured response mechanisms, have spoken out recently on the critical importance of nuclear energy in providing a major source of emission-free energy into the future.

Adding significant weight to the belief that the Federal Government should support a nuclear energy R&D program as part of its energy R&D portfolio is the November 5, 1997 report of the Energy Research and Development Panel of the President's Committee of Advisors on Science and Technology (PCAST). This Report acknowledges the 12-fold decrease in nuclear energy R&D since 1986, proposes an increase in R&D investment in nuclear energy to \$119M in 2003, and states clearly that "[nuclear] fission belongs in the R&D portfolio."

DOE and industry believe that nuclear energy R&D that supports the continued availability of a safe, predictable, and cost-effective nuclear option for U.S. electricity generation is of critical importance to the nation:

*"The vital national interests identified in the Yergin Report -- energy security, economic strength, environmental quality, and science and technology leadership -- are served by nuclear energy and a sustained R&D program that enables nuclear energy to continue to improve."*

EPRI President Kurt Yeager, in his July 3, 1997 letter to Energy Secretary Peña

*"We share your disappointment that the Department will have no active nuclear energy research and development program during FY 1998. The Nuclear Energy Security Program would have been an important element in our mission to help assure that the United States has a flexible, diverse, and environmentally responsible energy portfolio in the next century. ... Given growing concerns over global climate change and other environmental issues, the United States must maintain the option to both operate many of its current nuclear power plants and build new plants based on the designs that emerged from our Advanced Light Water Reactor Program."*

Secretary Peña, in his September 16, 1997 letter to members of the U.S. Senate

More recently, a number of U.S. Senators, including Pete Domenici and Frank Murkowski, have called for a renewed focus on nuclear energy R&D. Senator Domenici, in numerous recent speeches, is calling for a national dialogue with serious discussion about the full range of nuclear technologies. Regarding R&D, he stated:

*"An excellent report by Dr. John Holdren for the President's Committee of Advisors on Science and Technology, calls for a sharply enhanced national effort [on nuclear energy R&D]. It urges a 'properly focused R&D effort to see if the problems plaguing fission energy can be overcome -- economics, safety, waste, and proliferation.' I have long urged the conclusion of this report -- that we dramatically increase spending in these areas for reasons ranging from reactor safety to non-proliferation."*

Senator Murkowski, in a recent letter to Franklin Raines, Director of the Office of Management and Budget (OMB), stated:

*“Nuclear energy is responsible for the vast majority of the carbon emissions avoided by the U.S. under our Climate Action Plan. While there are further advances that can be made in energy efficiency and new energy technologies, any realistic assessment of future U.S. energy requirements concludes that we cannot meet the Kyoto standards or the even tougher standards likely to follow without increasing our reliance on nuclear energy.*

*The President’s Committee of Advisors on Science and Technology (PCAST) recognizes this reality. Their recent report recognizes the benefits of expanding nuclear energy to address atmospheric carbon concentrations. Consequently, they recommend increases in spending for nuclear energy research and development. Similarly, the Directors of seven DOE national labs have recently written Energy Secretary Peña with the same message.*

*As you complete your final review of the President’s FY 1999 budget submission to Congress, I urge you to keep these realities in mind. Our best scientific minds are telling us we need to expand our use of nuclear energy at a time when keeping existing plants on line is a growing challenge. If the Administration is truly concerned about carbon emissions and climate change, I urge that this concern be demonstrated by the inclusion of the peer-reviewed Nuclear Energy Research Initiative (NERI) and the U.S. Nuclear Power Plant Climate Initiative in the President’s budget submission.”*